Active Project (2015 - 2017)

Advanced Algorithms and Controls for Superior Robotic All-Terrain Mobility, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

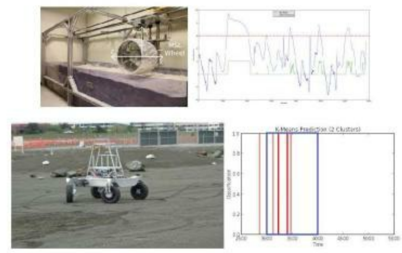
ABSTRACT

ProtoInnovations, LLC (PI) and the Massachusetts Institute of Technology (MIT) have formed a partnership to research, develop, and experimentally characterize a suite of robotic controls to significantly improve the safety, mean travel speed, and rough-terrain access of wheeled planetary rovers. In meeting this goal we have been developing algorithms for all-terrain adaptive locomotion which include: 1. Advanced traction controls, which intelligently govern individual wheel commands as a function of terrain conditions in order to measurably decrease wheel slip; and, 2. Real-time incipient embedding detection controls, which monitors the rover's inertial signature to rapidly and robustly detect instances of incipient embedding in soft, low bearing-strength soils. The implementation of these controls will not only allow rovers to autonomously detect and avoid hazardous terrain regions, but also to travel with assured safety on terrain that is steeper and rougher than is currently possible. Moreover, these controls will allow rovers to drive with a reduced risk of catastrophic failure, while simultaneously increasing both the quantity and potential quality of science data products. This latter capability is enabled by the fact that rovers will be able to travel for long durations without requiring lengthy human interventions, and will be able to travel to sites of greater scientific interest (and proportionally greater mobility difficulty) than what is possible today.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The proposed research is expected to greatly enhance the mobility and tractive performance of robotic planetary rovers. In Phase 2 we will demonstrate our advanced traction control methods to various individuals at NASA centers, with the aim of identifying potential future missions for transition of this technology. The 2020 Mars rover mission is an example of such mission that could directly



Advanced Algorithms and Controls for Superior Robotic All-Terrain Mobility

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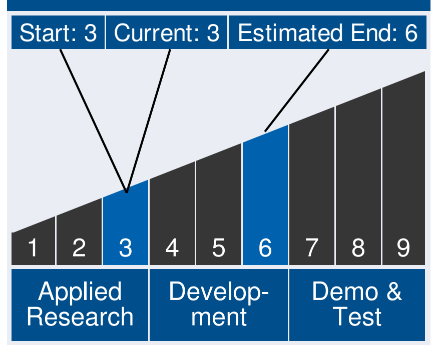

Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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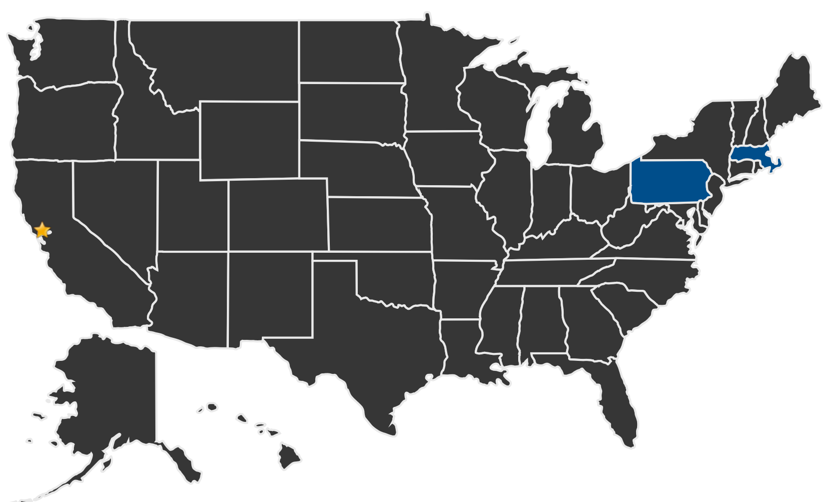
benefit from the algorithms and control methods developed under this STTR project. The PI/MIT team will actively seek post-Phase 2 support to further develop, mature, and integrate our control technology into future NASA missions.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Beyond NASA, there is a large and growing application space for mobile robotic systems in applications such as defense and security, mining and forestry, and infrastructure monitoring and inspection. Many of these systems are tasked with traveling at low speeds through very difficult terrain. The PI/MIT team will aim to transition the technology developed under this project beyond NASA, to dual-use applications in these various sectors.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center: Ames Research Center

Other Organizations Performing Work:

- Massachusetts Institute of Technology
- ProtoInnovations, LLC (Pittsburgh, PA)

Management Team *(cont.)*

Program Manager:

- Carlos Torrez

Principal Investigator:

- KARL IAGNEMMA

Technology Areas

Primary Technology Area:
Robotics and Autonomous Systems (TA 4)
└ Mobility (TA 4.2)
  └ Small-Body and Microgravity Mobility (TA 4.2.4)
    └ Wheeled/Tracked/Hybrid Robots (TA 4.2.4.4)

Secondary Technology Area:
Robotics and Autonomous Systems (TA 4)
└ Mobility (TA 4.2)
  └ Extreme-Terrain Mobility (TA 4.2.1)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/17826)

DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced Algorithms and Controls for Superior Robotic All-Terrain Mobility